

#### IV. DEINOSUCHUS<sup>1</sup> HATCHERI,<sup>2</sup> A NEW GENUS AND SPECIES OF CROCODILE FROM THE JUDITH RIVER BEDS OF MONTANA.

By W. J. HOLLAND.

Upon the occasion of the geological reconnaissance undertaken jointly by Mr. T. W. Stanton and Mr. J. B. Hatcher under the auspices of the United States Geological Survey in the summer of the year 1903, Mr. Hatcher found on Willow Creek, three miles west of Nolan and Archer's ranch, in Fergus County, Montana, some fragmentary remains lying upon the surface of the soil. He picked up a couple of scutes, which he brought back with him to the Carnegie Museum, and at the same time referred them provisionally to *Stereocephalus tutus* Lambe.<sup>3</sup> Mr. W. H. Utterback was sent to the locality by Mr. Hatcher in the fall of 1903 with instructions to thoroughly explore the spot, and recover whatever could be found.

Mr. Utterback only succeeded in finding two vertebræ, one cervical rib, one fairly complete dorsal rib, fragments of other dorsal ribs, an os pubis, a large number of scutes, some of them quite perfect, and several hundred fragments of bones, some of them no doubt belonging to the skull, others to the vertebræ and ribs, but all of them so badly broken, and a few even water-worn, that it is impossible to refer them with any degree of certainty to their true position. The vertebræ and the ribs upon examination conclusively demonstrated, as the writer pointed out to Mr. Hatcher, that the animal was a huge crocodile. Mr. Hatcher immediately lost interest in the material, and though on several occasions urged to figure and describe the bones, turned from them to other things, which at the time possessed greater interest, and then came his untimely and melancholy end.

In 1905 Professor S. W. Williston urged the writer to describe the specimen, but, though the work was begun, it is only recently that the

<sup>1</sup> δεινός = terrible; σοῦχος = crocodile.

<sup>2</sup> I take pleasure in naming the species after my associate and friend, the late Mr. John Bell Hatcher, who was the discoverer of the specimen.

<sup>3</sup> Contributions to Canadian Paleontology, Vol. III, pp. 55 *et seq.* Cf. Barnum Brown, *Bull. Am. Mus. Nat. Hist.*, Vol. XXIV, pp. 187-201.

writer has found time to complete the brief sketch of these interesting remains, which is here given.

The type (No. 963 Carnegie Museum Catalog of Vertebrate Fossils) consists of two vertebræ; a cervical rib; the first dorsal rib of the left side; fragments of several other dorsal ribs; an os pubis; twenty-five scutes in fairly good condition, and numerous fragments of others; and in addition several hundreds of comminuted fragments of vertebræ, ribs, and bones of the skull, which furnish no contacts, and defy efforts to successfully collocate them. Some of these fragments are more or less water-worn, and consist simply of bits of bone which were for the most part found by Mr. Utterback upon the surface, where the skeleton had been weathered out, and trodden under foot. Some of them suggest that they have been exposed to the action of fire, and this might well have been the case when prairie-fires swept over the spot.

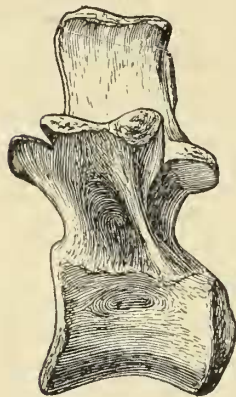


FIG. 1. Lateral view of left side of seventh (?) dorsal vertebra of *D. hatcheri*.  $\frac{1}{9}$  nat. size.

*Generic characters of Deinosuchus so far as known.* Great size, exceeding that of any other representative of the Crocodilia thus far described from North America.<sup>4</sup> Scutes massive and possessing great vertical height in comparison with their breadth, many of the smaller scutes being almost hemispherical, and some of the smallest subglobose. Pubis straighter and less deeply excavated posteriorly than in recent crocodilia. Extremities of dorsal spines of vertebræ broad transversely and thickened for attachments, much more so than in existing genera. The postzygapophyses of the vertebræ more nearly on the same plane as the transverse processes and not looking outwardly as much as in other crocodiles.

#### SEVENTH (?) DORSAL VERTEBRA.

(C. M. Cat. Vert Foss., No.  $\frac{963}{1}$ .)

The specimen, which almost beyond a doubt is the seventh in the dorsal series, is the better preserved of the two vertebræ which were recovered. It is procœlous. At the extremities of the transverse

<sup>4</sup> The writer has carefully examined and inquired in various museums at home and abroad and has been unable to find in any of them the fossil remains of any crocodile from North America equaling in size those here reported upon.

processes it shows the articulating surfaces for the ribs. It is a very massive bone and the dorsal spine is broad above, being greatly

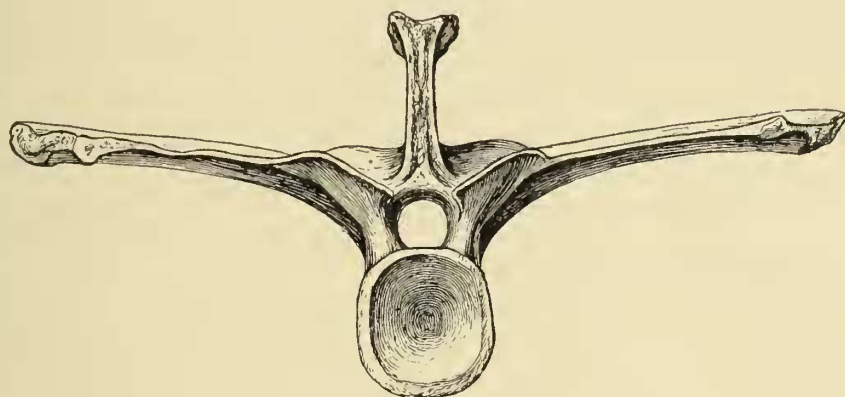


FIG. 2. Anterior view of seventh (?) dorsal vertebra of *D. hatcheri*.  $\frac{1}{9}$  nat. size.

thickened transversely for attachment to adjacent structures. The postzygapophyses do not look as strongly outwardly as in the recent crocodilia, the under surfaces lying at their outer extremities nearly

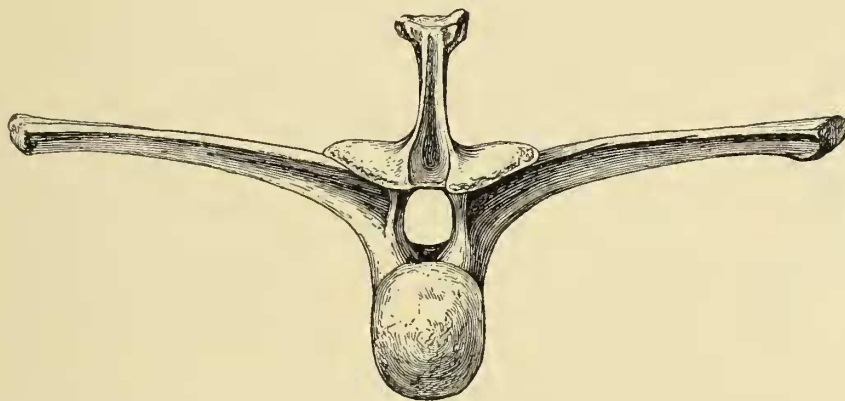


FIG. 3. Posterior view of seventh (?) dorsal vertebra of *D. hatcheri*.  $\frac{1}{9}$  nat. size.

in the same plane as the upper surface of the transverse processes. Three views of the vertebra are given in Figures 1-3.

#### DIMENSIONS.

Extreme width from tip to tip of transverse processes.....	680 mm.
Height from bottom of centrum to tip of spine... ..	310 "
Extreme length across zygapophyses.....	180 "
Length of centrum at middle.....	140 "
Length of centrum along floor of neural canal.....	125 "
Vertical diameter of centrum in front.....	122 "
Transverse diameter of centrum in front.....	122 "
Vertical diameter of centrum behind.....	110 "

Transverse diameter of centrum behind .....	95 mm.
Vertical diameter of neural canal.....	52 "
Transverse diameter of neural canal .....	35 "
Height of spine above neural canal.....	150 "
Height of spine above postzygapophyses.....	105 "
Height of spine above prezygapophyses.....	135 "
Antero-posterior diameter of spine at base.....	110 "
Antero-posterior diameter of spine at top.....	87 "
Transverse diameter of spine at base posteriorly.....	30 "
Transverse diameter of spine at base anteriorly.....	30 "
Transverse diameter of spine at top .....	65 "
Distance across postzygapophyses.....	173 "
Distance across prezygapophyses at their base.....	230 "

## LAST LUMBAR VERTEBRA.

(C. M. Cat. Vert. Foss., No.  $\frac{963}{2}$ .)

The vertebra under consideration is not so well preserved as the one described in the preceding paragraph, but the extremity of the left transverse process is sufficiently complete to show that it did not carry ribs. I assign it with doubt to the position of the last member of the lumbar series on account of the manner in which the spine and postzygapophyses overhang backwardly. If not that it must be one or the other of the two vertebræ immediately preceding. In general appearance it is not unlike the seventh (?) vertebra already described, except that the transverse processes are much narrower and the left, which is well preserved, shows no articular surfaces at the end. The spine has a much smaller antero-posterior diameter at the top than the seventh dorsal and its posterior margin is placed more decidedly caudad than in that vertebra. Fig. 4 shows the left side of the vertebra, which is the more complete, and which may be compared with the corresponding view of the seventh dorsal.

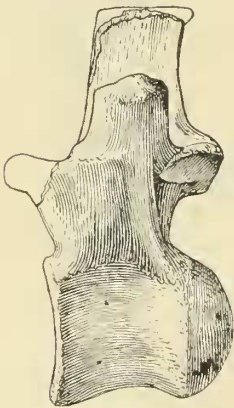


FIG. 4. Lateral view of the left side of the last (?) lumbar vertebra of *D. hatcheri*.  $\frac{1}{9}$  nat. size.

## DIMENSIONS.

Extreme width from tip to tip of transverse processes*.....	670 (?) mm.
Height from bottom of centrum to tip of spine † .....	320 ± "

\* The right transverse process is broken; the measurement given represents twice the distance from the middle of the spine to the end of the left transverse process.

† The top of the spine appears to be broken, and may not quite represent the true length in life.



Extreme length across zygapophyses.....	160 ± mm.
Length of centrum at middle.....	150 "
Length of centrum along floor of neural canal.....	90 "
Vertical diameter of centrum in front.....	130 "
Transverse diameter of centrum in front .....	105 "
Vertical diameter of centrum behind.....	110 "
Transverse diameter of centrum behind.....	85 "
Vertical diameter of neural canal.....	53 "
Transverse diameter of neural canal.. ..	35 "
Height of spine above neural canal.....	158 ± "
Height of spine above postzygapophyses.....	105 "
Height of spine above prezygapophyses.....	155 "
Antero-posterior diameter of spine at base.....	110 "
Antero-posterior diameter of spine at top.....	67 "
Transverse diameter of spine at base posteriorly.....	28 "
Transverse diameter of spine at base anteriorly.....	10 "
Transverse diameter of spine at top.....	40 ± "
Distance across postzygapophyses.....	200 "
Distance across prezygapophyses at their base.....	230 ± "

## CERVICAL RIB.

(C. M. Cat. Vert. Foss., No.  $\frac{963}{3}$ .)

A fairly well preserved specimen of the first cervical rib of the left side was found. At its proximal end it has been somewhat broken, but not enough to greatly diminish its length. Its proportions and general appearance are represented in Fig. 5, *a* representing the inner, and *b* the outer surface of the bone.

## DIMENSIONS.

Greatest length.....	235 mm.
Width at proximal end.....	37 "
Smallest width at proximal end.....	28 "
Greatest width in distal half.....	51 "
Width at distal extremity.....	17 "
Transverse diameter at proximal end.....	18 "
Transverse diameter at distal end.....	8 "

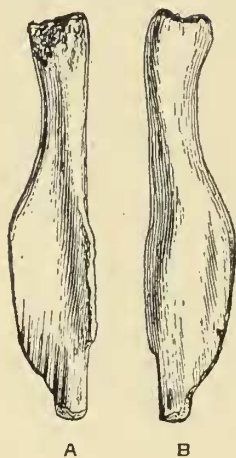
## DORSAL RIBS.

(C. M. Cat. Vert. Foss., No.  $\frac{963}{4}$ .)

A fairly well preserved specimen of the first dorsal or thoracic rib of the left side was recovered. Its shape is represented in Fig. 6, *A* showing the posterior, and *B* the anterior surface of the rib. It had been broken about the middle of the shaft and was repaired in the

laboratory. The writer has been assured that the contacts within, which are not now visible, justified the proportions which are shown by the specimen, but nevertheless is disposed to believe that the restored bone does not quite fully represent the entire length of the sternal part as it was in life. It is proportionately considerably shorter in its total length than the corresponding bone in other crocodilians. The relative length and shape of the capitulum and tuberculum is very like what is seen in the crocodiles of to-day. The tuberosity is well developed and directed forward and slightly more downward than in recent crocodilia.

FIG. 5. First cervical rib of *D. hatcheri*.  $\frac{1}{6}$  nat. size. *a*, inner surface; *b*, outer surface.



In addition to the specimen which is here figured there were found a number of fragments of ribs, one of them apparently the proximal end with the capitulum of the third thoracic rib of the left side; another evidently a piece of the upper portion of the first rib of the right side carrying the tuberosity, but lacking the capitulum and tuberculum, and still another which is apparently the

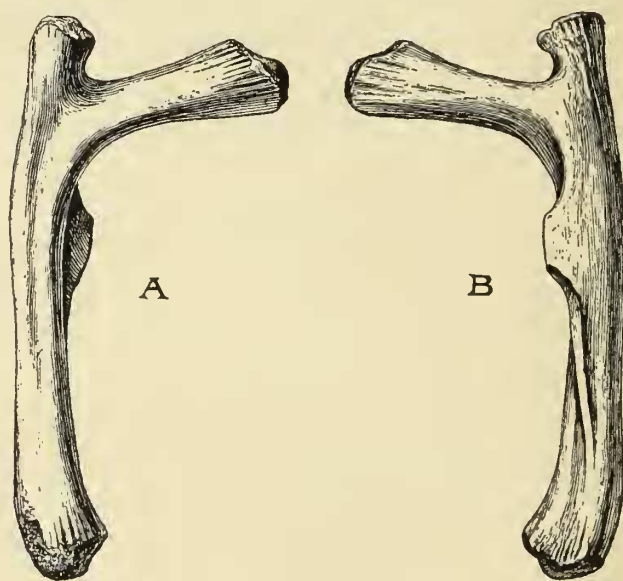


FIG. 6. Seventh (?) dorsal rib of *D. hatcheri*.  $\frac{1}{8}$  nat. size. *a*, posterior surface; *b*, anterior surface.

proximal end of the fifth dorsal. A few fragments of the distal end of the ribs also occur in the mass of bones picked up by Mr. Utterback.

DIMENSIONS.

(First left dorsal rib. See Fig. 6.)

Greatest length from end of tuberculum to distal extremity.....	460 mm.
Distance from outer edge of tuberculum to extremity of capitulum...	220 "
Greatest width of rib over tuberosity.....	80 "
Greatest width of capitulum at end.....	60 "
Antero-posterior diameter of capitulum at end.....	32 "
Greatest width of tuberculum at end.....	50 "
Antero-posterior diameter of tuberculum .....	30 "
Greatest width of distal end of rib.....	60 "
Antero-posterior diameter of rib at end.....	35 "

THE PUBIS.

(C. M. Cat. Vert. Foss., No.  $\frac{963}{11}$ .)

A very well preserved specimen of the right pubic bone was recovered. It agrees very closely in its general outline and proportions with the corresponding bone in recent crocodiles, but is somewhat less rounded on its distal margin and decidedly less excavated on its pos-

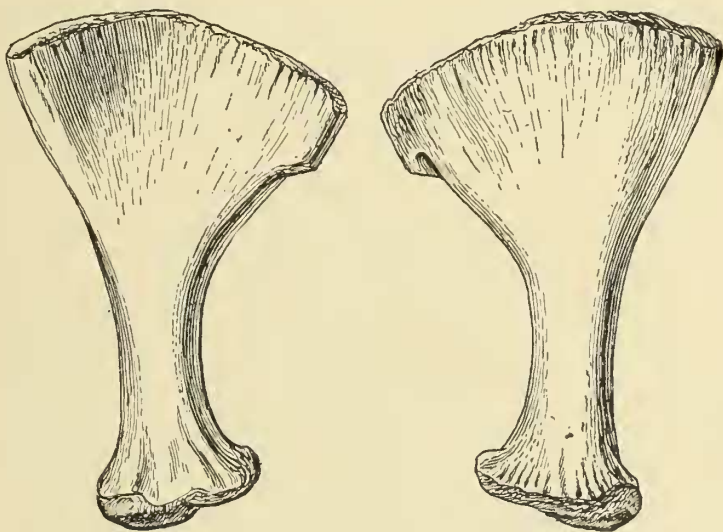


FIG. 7. Right pubis of *D. hatcheri*. About  $\frac{1}{8}$  nat. size. Figure on the left upper surface; on the right lower surface.

terior margin, at least when compared with the specimens of *Crocodylus* and *Alligator* before me. It is represented in Fig. 7, the illustration at the left of the cut showing the superior, and that on the right of the cut the inferior surfaces of the bone, the strongly curved, or excavated, side being the anterior margin.

## DIMENSIONS.

Distance from proximal extremity to distal extremity of posterior margin....	287 mm.
Distance from proximal extremity to distal extremity of anterior margin....	223 "
Antero-posterior diameter of proximal end.....	100 "
Vertical diameter of proximal end.....	55 "
Smallest antero-posterior diameter of shaft.....	45 "
Vertical diameter of shaft.....	30 "
Greatest width of distal end.....	200 "
Vertical diameter at posterior angle of distal margin.....	23 "
Vertical diameter at anterior angle of distal margin.....	10 "

## THE SCUTES.

Of the scutes representing the specimen there are twenty-five, which are in fairly good condition, and numerous fragments of others.

In a beautifully perfect skeleton of *Crocodylus acutus floridanus* before me as I write I find that there are ninety-two osseous scutes entering into the dermal covering of the neck and back.

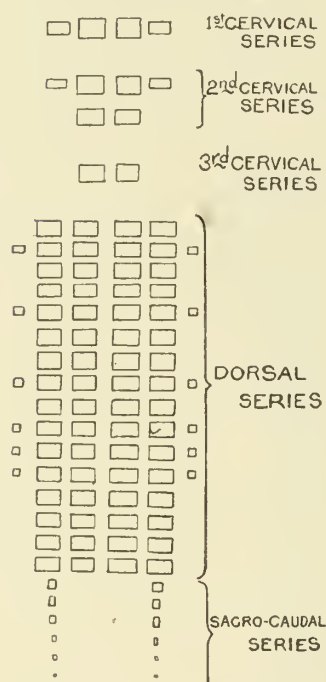


FIG. 8. Diagrammatic view of arrangement of scutes on back of *C. acutus floridanus*.

The anterior series forms a transverse row of four scutes located immediately over and covering the spine of the axis; the second series consists of two transverse rows, the first made up of four scutes, the second of two scutes, and these overlies and cover the spines of the third, fourth, and fifth cervicals. The third series is composed of two scutes, covering the spine of the sixth cervical. The spine of the seventh cervicals is not shielded above by a row of scutes; and the spine of the eighth cervical is only partially covered by the first transverse row of the dorsal series of scutes. The dorsal series is made up of fifteen transverse rows of scutes, each row composed of four or six bony plates. Those containing six plates are the second, the fifth, the eighth, the tenth, eleventh, and twelfth rows, reckoning backward. The fifteenth transverse row of scutes, overlies and

covers the spines of the third and fourth lumbar vertebræ. Following the dorsal series of scutes terminating at the point just stated, there are on either side, extending backward over the region of the sacrum and the two anterior caudal vertebræ, six bony scutes dimin-



ishing in size backward and forming the backward prolongation of the second longitudinal row of scutes reckoning from the median line

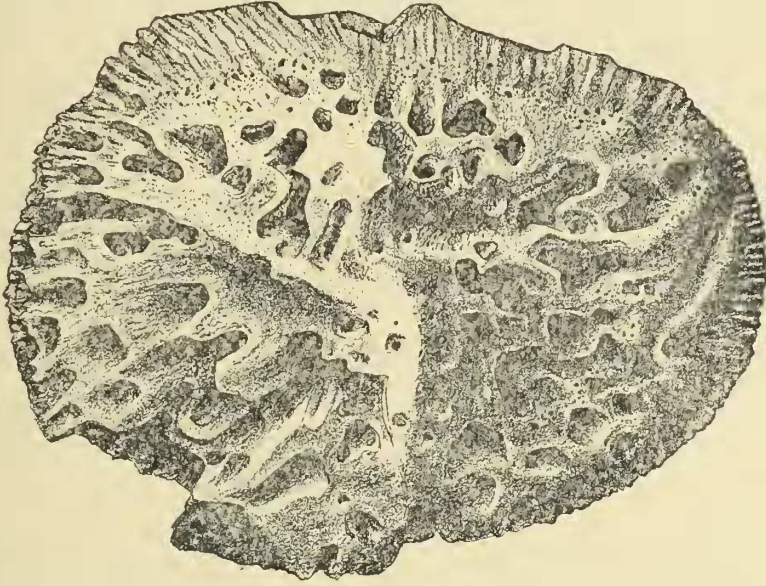


FIG. 9. Cervical scute ( $\frac{9.63}{1.2}$ ). Dorsal view.  $\frac{1}{2}$  nat. size.

outwardly on either side. The arrangement of the scutes in *C. floridanus* is represented diagrammatically in Fig. 8.

All the scutes in *D. hatcheri* are characterized on the superior sur-

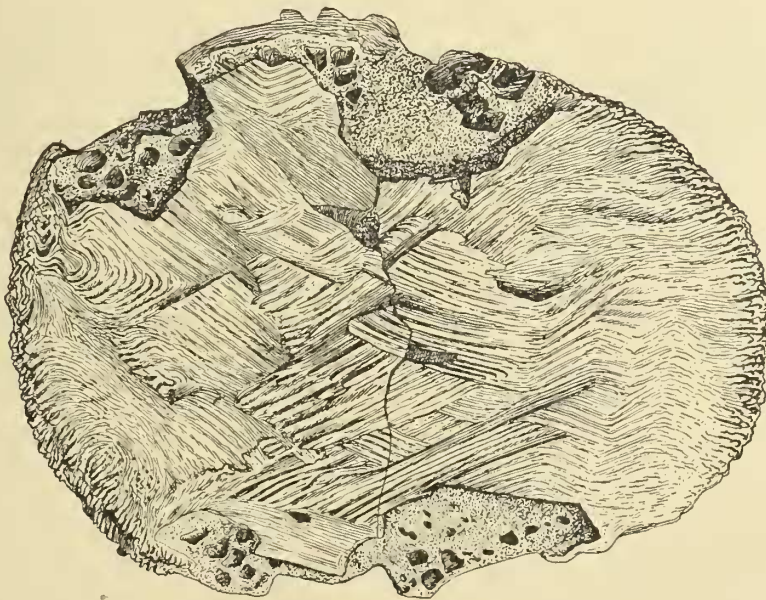


FIG. 10. Cervical scute ( $\frac{9.63}{1.2}$ ). Ventral view showing traces of adhesions to the corium.  $\frac{1}{2}$  nat. size.

face by an elevated longitudinal median ridge or carina, which does not, however, rise as sharply from the surface as in recent genera, and

as is shown in the figures herewith given, passes by almost insensible degrees into the surface of the adjoining parts of the scutes.

An attempt has been made by comparison with the scutes as they exist upon the back of recent crocodiles to ascertain the relative posi-



FIG. 11. Cervical scute ( $\frac{963}{13}$ ). Dorsal view. *a*, anterior margin; *b*, posterior margin. About  $\frac{1}{4}$  nat. size.



FIG. 12. Cervical scute ( $\frac{963}{13}$ ). Posterior view. *l*, left; *r*, right side. About  $\frac{1}{4}$  nat. size.

tion of the scutes belonging to the specimen of *Deinosuchus hatcheri*, but the result has not been wholly satisfactory to the writer. The scute represented in Figs. 9 and 10 appears to undoubtedly correspond to the internal right scute of the first row in the second cervical series, and the scute represented in Figs. 11-13 to be its immediate successor in the second row of the same series. Fig. 14 represents what the



FIG. 13. Cervical scute ( $\frac{963}{13}$ ). *a*, front; *b*, back. Right lateral view. About  $\frac{1}{4}$  nat. size.



FIG. 14. Cervical scute ( $\frac{963}{15}$ ). Anterior view, showing great relative perpendicular height. About  $\frac{1}{4}$  nat. size.

writer believes to be the left scute of the third cervical series. The smaller scute represented in Fig. 16 no doubt belongs to the sacro-caudal series, and the large broad scutes, of which there are several well-preserved specimens, one of them shown in Fig. 15, can be referred approximately to their places about the middle of the dorsal series.

The scutes differ from those of all other crocodilia by their great vertical thickness in comparison with their length and breadth. They are not proportionally nearly as thin as those of any recent species, and the writer cannot discover in the literature of the subject, nor has he found in any of the collections at home or abroad crocodilian

scutes which are so heavy and massive as these. The smaller scutes are some of them almost hemispherical and a few of the smallest almost spherical in form, causing them thus to differ widely in appearance from those of other crocodilian scutes. This character is regarded by the writer as possessing generic value.

On the upper surface all of the scutes are deeply pitted on either side of the median longitudinal ridge, the pits being often confluent. The median ridge is also in almost all cases marked by a few narrow but deep circular pits. On the under side the scutes are slightly



FIG. 15. Dorsal scute ( $\frac{9.6.3}{1.4}$ ).  
About  $\frac{1}{4}$  nat. size.



FIG. 16. Sacro-caudal scute ( $\frac{9.6.3}{1.6}$ ).  
1, superior view ; 2, left lateral view ;  
3, posterior view ; a, front ; b, back.  
About  $\frac{1}{4}$  nat. size.

rounded at their edges in the case of the larger specimens, and quite rounded in the cases of the smaller specimens. They show on the under surface numerous fine straight lines decussating with each other at an angle of about forty-five degrees, indicating the structure of the dermal tissues in which they were imbedded and to which they adhered.\* On the anterior margin many of the scutes show bevelled margins to adapt them to union with the scutes which preceded them and evidently somewhat overlapped them in front.

DIMENSIONS OF SCUTES.

Cervical Scute. (See Figs. 9 and 10.)

(Carnegie Museum Cat. Vert. Foss. No.  $\frac{9.6.3}{1.2}$ .)

Antero-posterior diameter.....	111 mm.
Transverse diameter.....	143 “
Greatest vertical diameter.....	58 “

\* Sir Richard Owen (Report of the British Association for the Advancement of Science, 11th meeting, 1841, p. 71) calls attention to a similar feature in the scutes of *Goniopholis crassidens* Owen.



? Cervical Scute. (See Figs. 11-13.).

(Carnegie Museum Cat. Vert. Foss. No.  $\frac{863}{13}$ .)

Antero-posterior diameter.....	80 mm.
Transverse diameter.....	115 "
Greatest vertical diameter.....	60 "

Dorsal Scute. (See Fig. 15.)

(Carnegie Museum Cat. Vert. Foss. No.  $\frac{963}{14}$ .)

Antero-posterior diameter.....	103 mm.
Transverse diameter.....	160 "
Greatest vertical diameter.....	42 "

Sacro-caudal Scute. (See Fig. 16.)

(Carnegie Museum Cat. Vert. Foss. No.  $\frac{963}{16}$ .)

Antero-posterior diameter.....	60 mm.
Transverse diameter.....	37 "
Greatest vertical diameter.....	33 "

COMPARATIVE MEASUREMENTS OF THE CORRESPONDING BONES IN THE SKELETON OF CROCODYLUS FLORIDANUS (Carnegie Museum Accession No.  $\frac{1010}{2}$ ) AND THE TYPE OF DEINOSUCHUS HATCHERI (Carnegie Museum Cat. Vert. Foss., No. 963).

*Cervical Rib.*

	<i>C. floridanus.</i>	<i>D. hatcheri.</i>
Length .....	105 mm.	235 mm.
Width at proximal end.....	12 "	37 "
Smallest width in proximal half.....	9 "	28 "
Greatest width in distal half.....	13 "	51 "
Width at distal end.....	5 "	17 "
Transverse diameter at proximal end.....	6 "	18 "
Transverse diameter at distal end.....	2.5 "	8 "

*Dorsal Rib.*

Greatest length from end of tuberculum to distal extremity.....	125 mm.	460 mm.
Distance from outer edge of tuberculum to end of capitulum.....	50 "	220 "
Greatest width of rib over tuberosity.....	22 "	80 "
Greatest width of capitulum at end.....	10 "	60 "
Greatest width of tuberculum at end.....	15 "	50 "
Greatest width of distal end of rib.....	13 "	60 "



*Pubis.*

Distance from proximal end to distal end of posterior margin.....	78	mm.	287	mm.
Distance from proximal end to distal end of anterior margin .....	80	"	223	"
Antero-posterior diameter of proximal end..	23	"	100	"
Vertical diameter of proximal end.....	15	"	55	"
Smallest antero-posterior diameter of shaft..	12	"	45	"
Vertical diameter of shaft.....	9	"	30	"
Greatest width at distal end.....	54	"	200	"
Vertical diameter at posterior angle of dis- tal margin .....	5	"	23	"
Vertical diameter at anterior angle of distal margin .....	2.5	"	10	"

*Seventh Dorsal Vertebra.*

Extreme width across transverse processes..	158	mm.	680	mm.
Height from bottom of centrum to top of spine.....	60	"	310	"
Length across zygapophyses.....	60	"	180	"

*Last (?) Lumbar Vertebra.*

Extreme width across transverse processes..	135	mm.	670	mm.
Height from bottom of centrum to top of spine.....	83	"	320	"
Length across zygapophyses.....	58	"	160	"

The measurements given in the foregoing comparative table for *Crocodylus floridanus* yield a total of 1220, from which we obtain a general average of 43.5. The total of the measurements given for *Deinosuchus hatcheri* is 4617, yielding us a general average of 164.8. The length of the specimen of *Crocodylus floridanus* from the tip of the nose to the end of the tail, from which the measurements in the first column were derived, is 3050 mm. In the ratio of 43.5 to 164.8 we would find that the total length of *Deinosuchus hatcheri*, provided it was built on the same relative proportions as *Crocodylus floridanus*, would be 13,830 mm., or about 45 feet in length.

This method of calculating may be open to objection and the result may be somewhat excessive. We may approach the problem in another way. We may assume that the length of the seventh dorsal vertebra represents the average length of the vertebræ in the series. In fact the centra of the caudals about the middle of the tail in all crocodilian skeletons I have examined considerably exceed in length

the centra of the anterior vertebræ, though the last eight or nine rapidly decrease. The centrum of the seventh dorsal in the specimen of *C. floridanus* before me certainly is rather under than over the average length of the members of the series. The length of the seventh dorsal in *D. hatcheri* is almost exactly six inches. The number of vertebræ in the total series is sixty (?). This would give us a length of thirty feet, without taking into account the length of the skull from its point of union with the atlas to the tip of the snout, which in *C. floridanus* is as 13 to 60. Applying this proportion to the case in hand we would have a length of from five to six feet for the skull. Adding this to the length of the vertebral column back of the head we have thirty-five as the total length of the bony framework of the animal. It is therefore no exaggeration to say that *D. hatcheri* must have been a crocodile which possessed a length of from thirty-five to forty feet, exceeding thus in length the largest specimen of *C. porosus* of which we have record, which is said to have been thirty-three feet in length, and therefore the longest crocodile belonging to a living species, which has ever been observed.

*Deinosuchus hatcheri* was undoubtedly one of the hugest representatives of the Crocodilia which has existed upon our globe.